South Carolina Offshore Wind

Overview of Studies

Liz Kress and Eric Boessneck

Topics

I. Work that has been done so far.
II. Planned work, near term.
III. Further work that is needed.
IV. Wind data review – Eric Boessneck

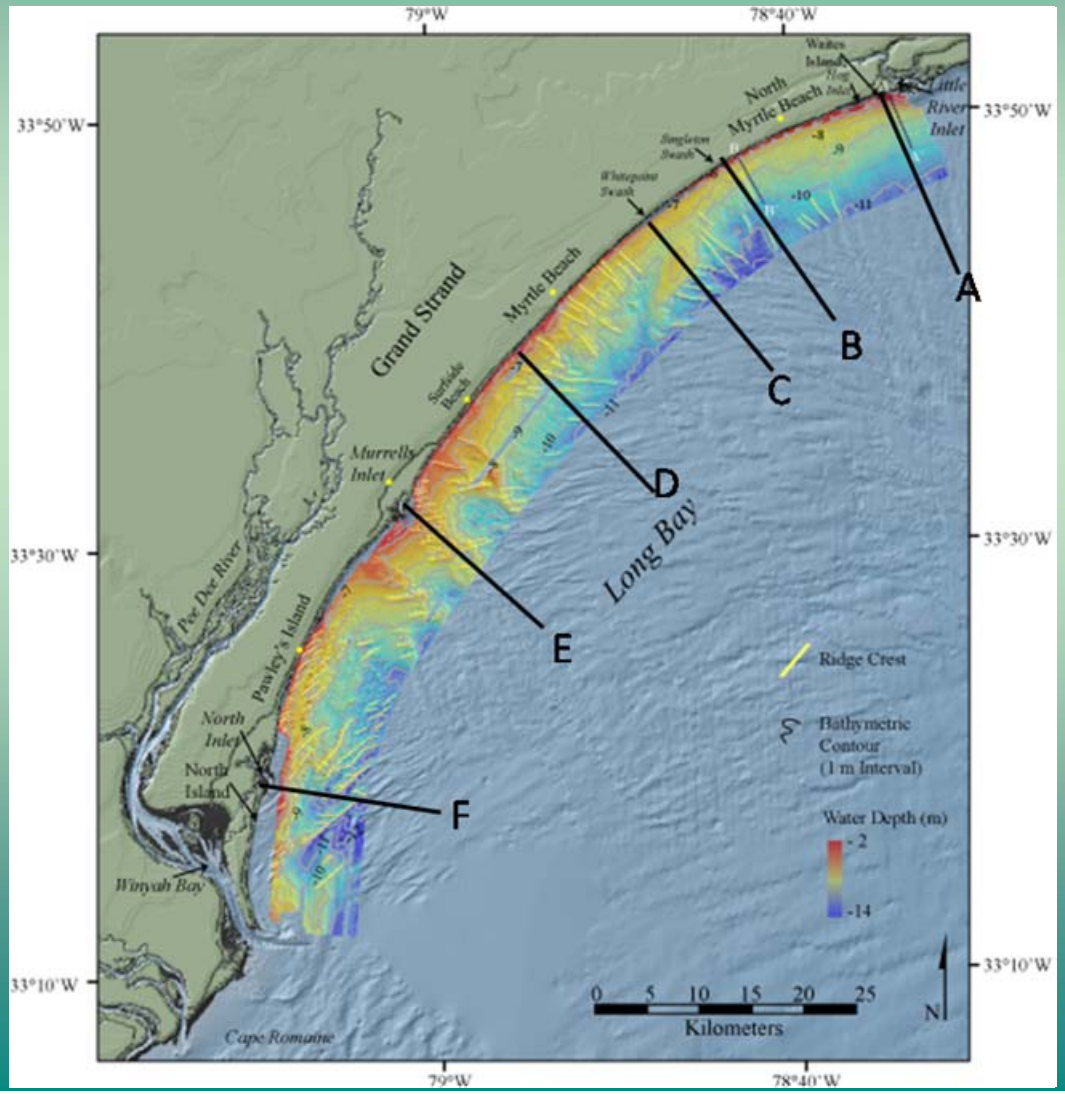
Wind Study Overview

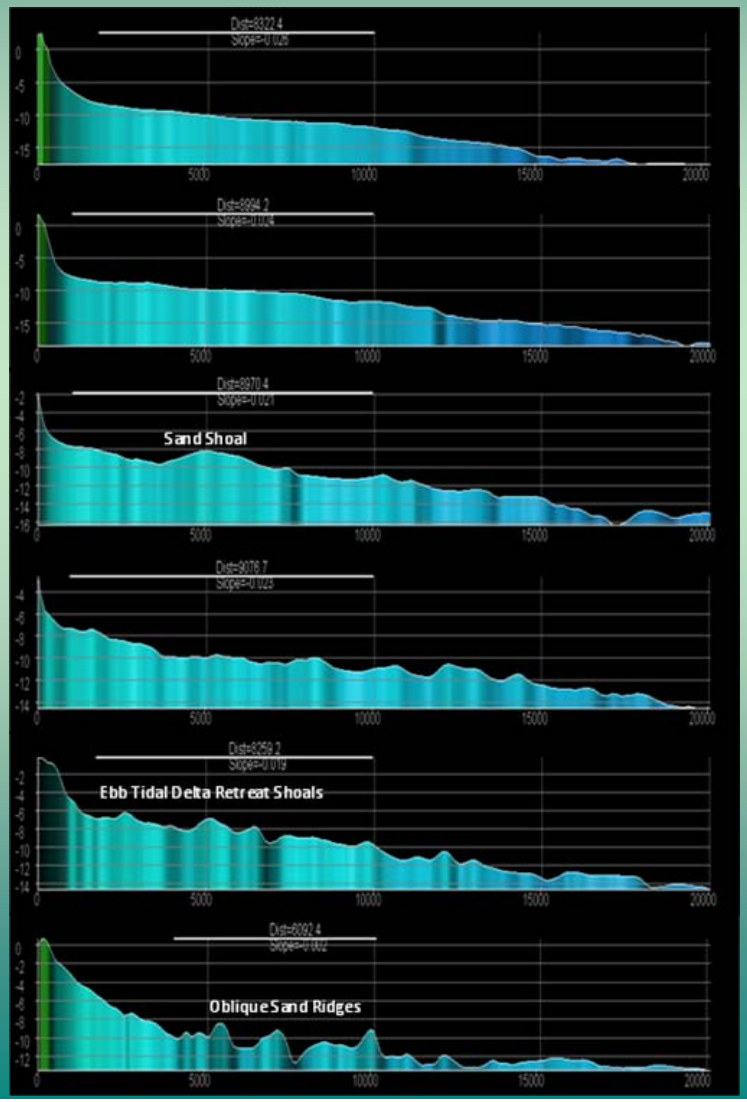
- Wind Mapping
- Southeast Regional Off-shore Wind Symposium
- Five Anemometer Stations
- SODAR development for offshore use
- Coastal Wind for Schools Program

  3 schools, Coastal Carolina Univ and SCCHR
- Extensive Study of Offshore Wind Potential
  - **In partnership with SC Energy Office, CCU, Sav River Nat Labs, Clemson (CURI and SCIES), Eco-Energy**
  - **Grants to develop the data, plans and rules needed**
  - **As far advanced as any other state in our study (just no name on a project)**

Physical Oceanography

- Depth Contours

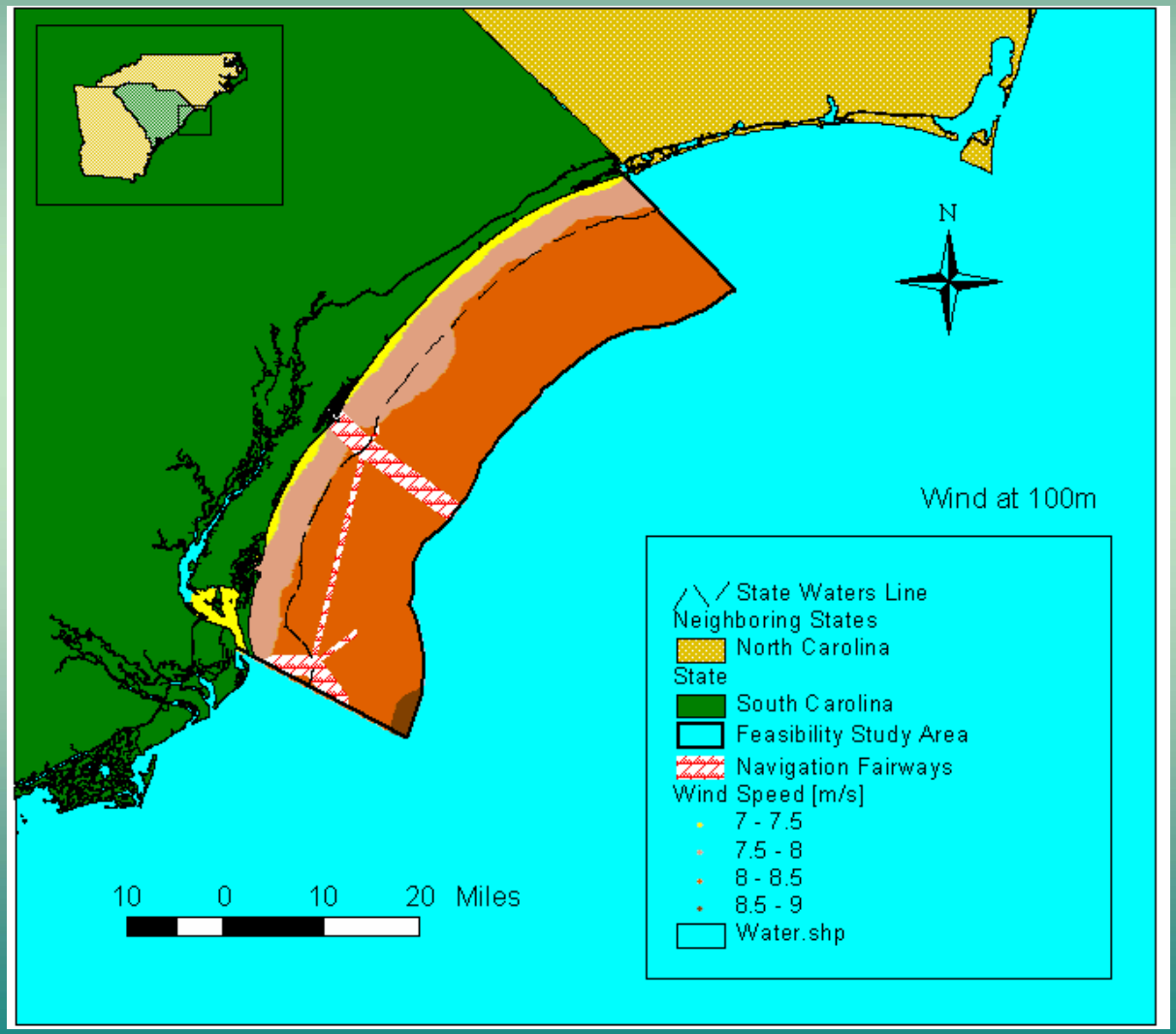




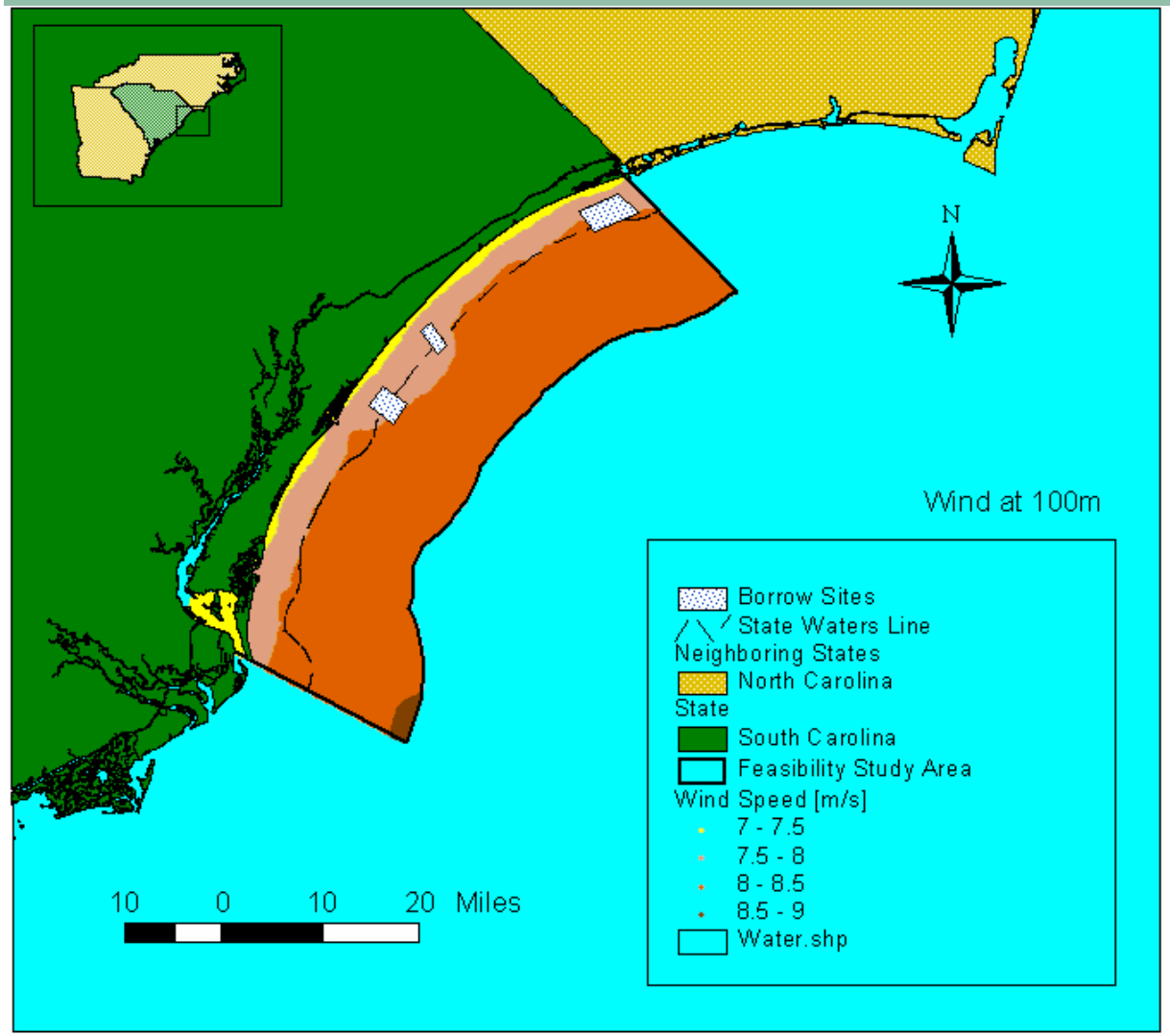
Environmental Impact Conclusions

- Environmental impacts appear to be acceptable
- Careful site selection is critical
- Bird migratory and breeding areas may impact locations
- Whales, dolphins and manatee will be impacted during construction phase
- Turtles could be impacted, especially in coastal areas (cabling)
- Site specific studies should be performed

Site Selection - Exclusion Zones
- Navigation Fairways



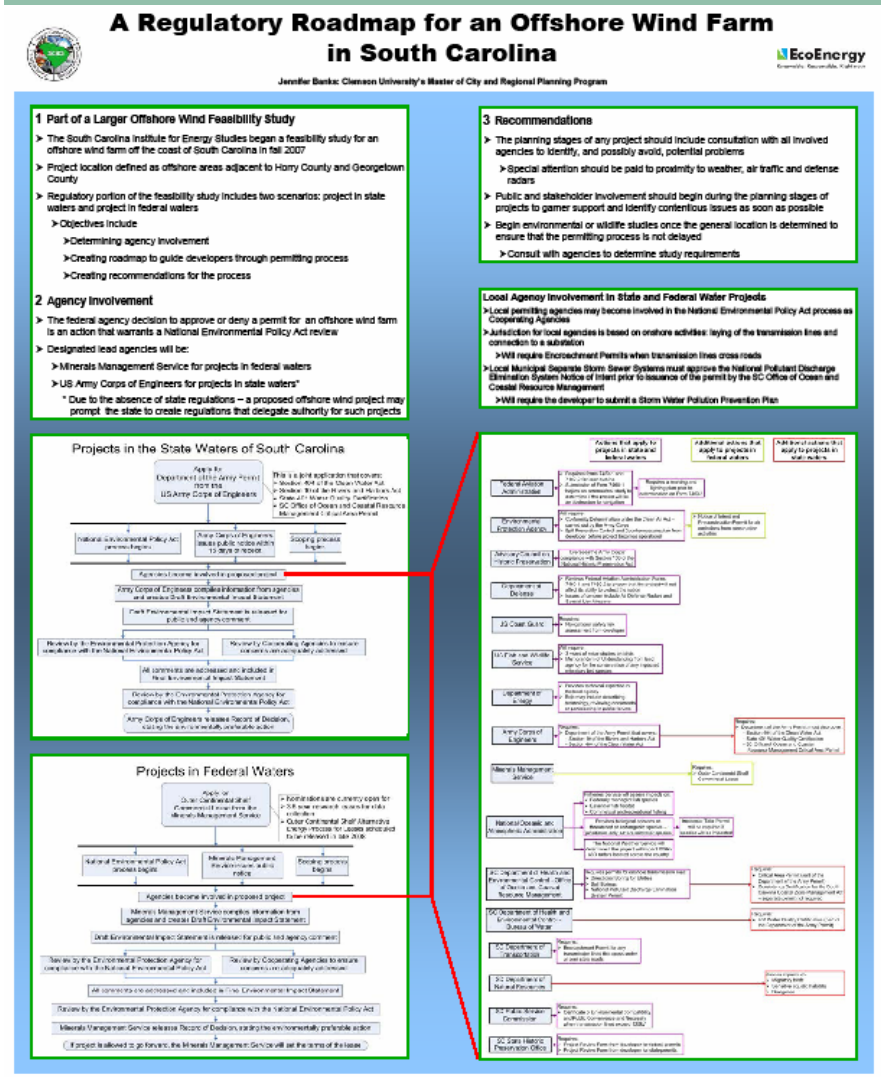
Site Selection - Exclusion Zones
- Remaining Feasible Areas



Exclusion Zones Studied

- Navigation
- Aviation
- Surveillance Radars
- Wrecks and Obstacles
- Reefs
- Special Fish Mgmt Zones
- Dredge Dump Sites
- Sand Borrow Areas
- Fish Habitat Areas
- Shellfish Harvest Areas
- Red Drum Habitats

South Carolina Offshore Wind Permitting Study



Focus topic from Clemson's Offshore Wind Feasibility

Jennifer Banks, MS Thesis – now working for AWEA

Topics

I. Work that has been done so far.

II. Planned work, near term.

III. Further work that is needed.

IV. Wind data review – Eric Boessneck

SC Roadmap to Gigawatt-Scale Coastal Clean Energy Generation: Transmission, Regulation, Demonstration

3-part Mission:

1. Study Transmission Infrastructure and Develop Options for Integrating Offshore Wind
2. Study Wind, Wave and Current Energy for Wind Turbine Foundation Design and for Other Potential Marine Energy Development
3. Regulatory Coordination Task Force to Develop Permitting Process

Partners:

SCEO CURI CCU
Santee Cooper NCSU

Transmission Study

- Clemson Univ's South Carolina Institute for Energy Studies (SCIES)- lead
- Clemson Univ Electric Power Research Association will assist
  - Has access to transmission information
  - Has support and coordination in place with other state utilities (Scana, Duke, Progress)
- Addressing best way to integrate up to 3GW of offshore wind
  - Intermittency
  - Transmission access from offshore
  - etc.

Buoy Study

- Palmetto Winds Research Project
- Study Wind, Wave and Current Energy for Wind Turbine Foundation Design and for Other Potential Marine Energy Development.
- 6 instrumentation buoys and 2 shore-based observation stations deployed along lines out from Winyah Bay and Little River.
- DOE Grant provides partial funding, and Santee Cooper provided additional funding to extend study to one year in duration.
- After 6 months of data, will look for a site for an anemometer station.

Regulatory Task Force

- SC Energy Office will coordinate a team of the necessary state agencies to develop offshore wind regulations for the state.

- Catherine Vanden-Houten is here to introduce her approach to this.

Topics

I. Work that has been done so far.

II. Planned work, near term.

III. Further work that is needed.

IV. Wind data review – Eric Boessneck

Key Issues for Wind Power

- Policy Uncertainty
- Siting and Permitting: avian, noise, visual, federal land
- Transmission: FERC rules, access, new lines
- Operational impacts: intermittency, ancillary services, allocation of costs
- Accounting for non-monetary value: green power, no fuel price risk, reduced emissions

Future Study Needs

I. Permit Application for Offshore Anemometer

II. Port Refurbishment Study
- Georgetown – niche facility for construction support and O&M support
- Charleston – possible manufacturing site for wind turbine components (old Navy base?)

III. Public Outreach and Education for Offshore Wind Development

IV. Workforce Development in SC

V. Economic Development in SC- recruiting new industry?

VI. Environmental Impact Study

Topics

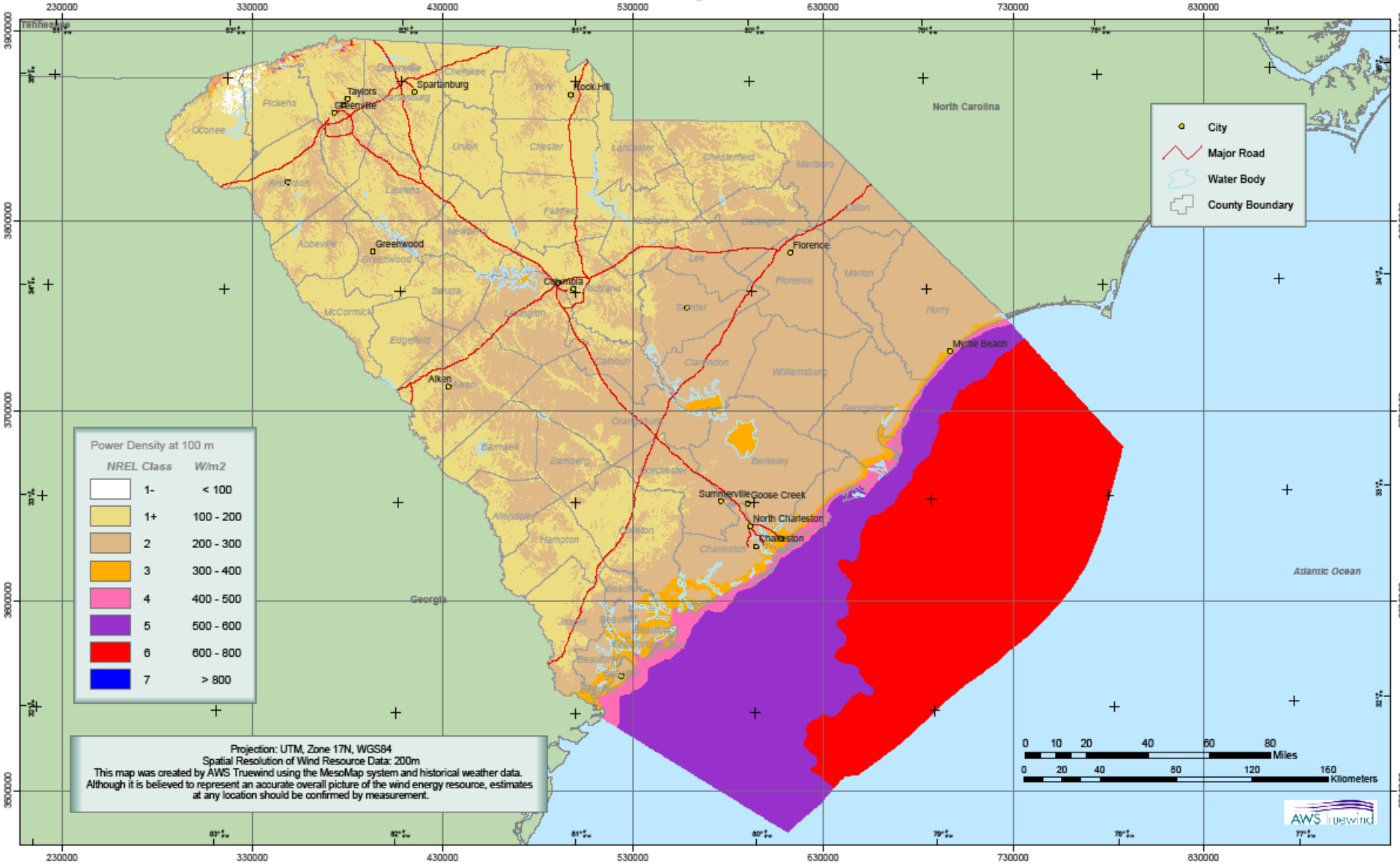
I. Work that has been done so far.

II. Planned work, near term.

III. Further work that is needed.

IV. Wind data review – Eric Boessneck

Mean Annual Wind Power Density of South Carolina at 100 Meters



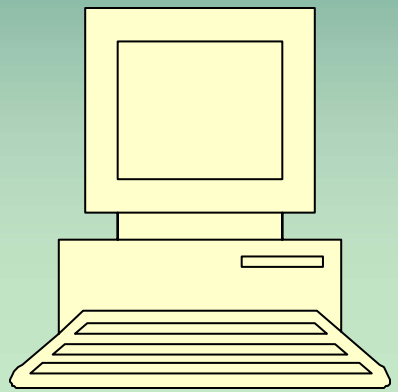
Review of Existing Data

Data managed and made available by NOAA

Station ID	Station Type	Station Manager	Location	Distance Offshore km (mi)	Anemometer Height m (ft)	Water Depth m (ft)
FPSN7	Light Tower	National Data Buoy Center (tower is decommissioned)	SE of Southport, NC	61 (38)	44.2 (145)	14[2] (46)
SNSN7	Water Level	Caro-COOPS	Sunset Beach, NC	Pier-based	9 (30)	1 (3.3)
41024	Buoy	Caro-COOPS	SE of Sunset Beach	2.5, (1.6)	3 (10)	11 (36)
41027	Buoy	Caro-COOPS	SE of Sunset Beach	71.3 (44.3)	3 (10)	28 (92)
NIWS1	Weather	National Estuarine Research Reserve System	North Inlet-Winyah Bay Reserve, SC	Pier-based	10.7 (35)	--
MROS1	Water Level	NOAA's National Ocean Service	Springmaid Pier, SC	Pier-based	9 (30)	1 (3.3)

One Year Wind Study – 3 Sites

NRG 50M Mobile
Anemometer Station



Clemson
University

Data Logger

Real-time Data Acquisition

Santee Cooper

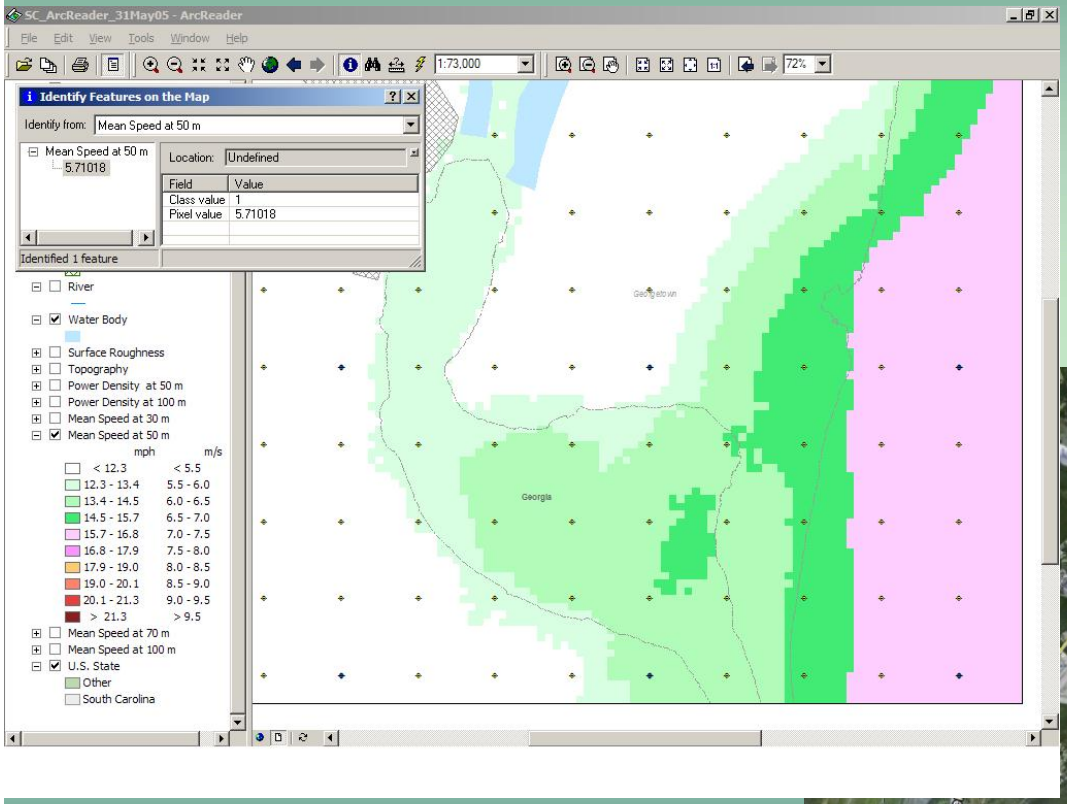
Public

Host Institution

Station at Coastal Carolina University Waties Island: June 2007

Station at Baruch Foundation, Georgetown: August 2008

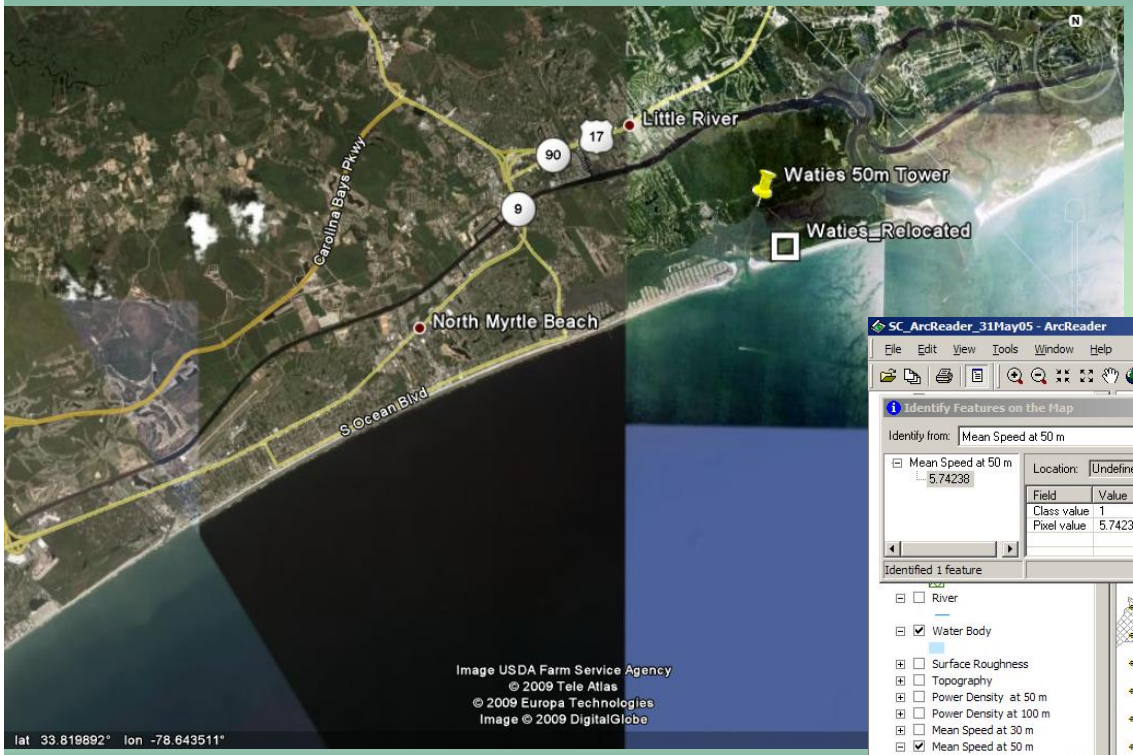
50m Tall Tower Data: Correlation

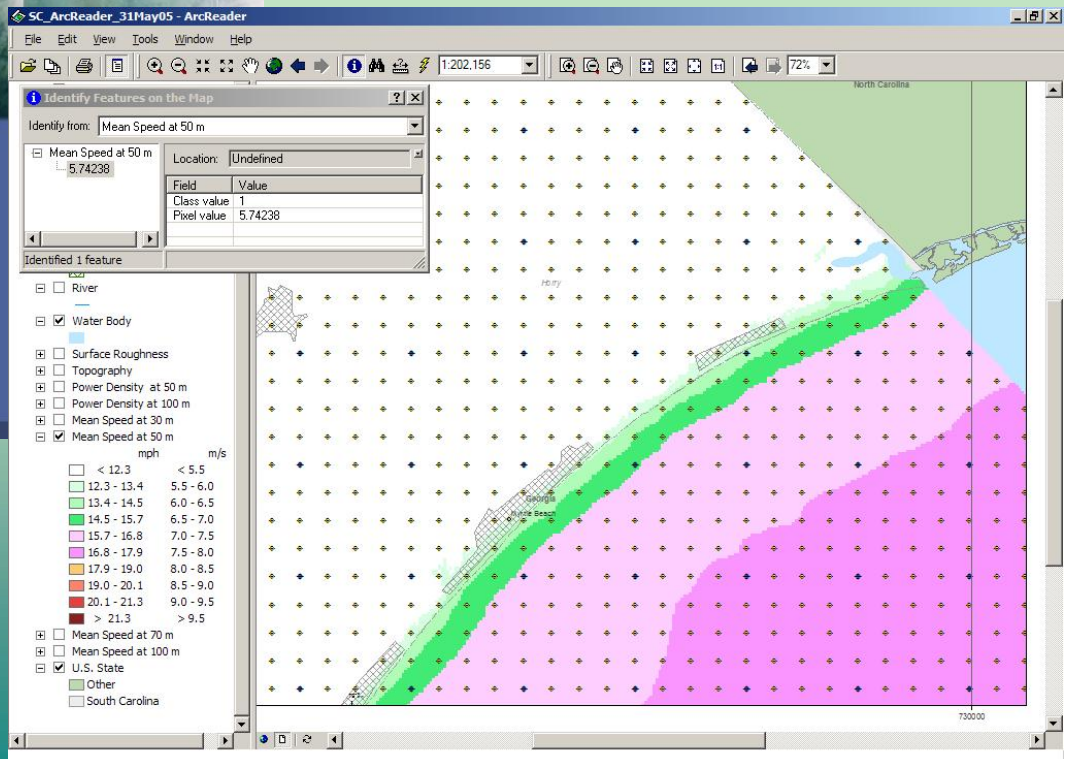


Baruch Data: 5.7 m/s

AWS Prediction: ~5.8 m/s

50m Tall Tower Data: Correlation



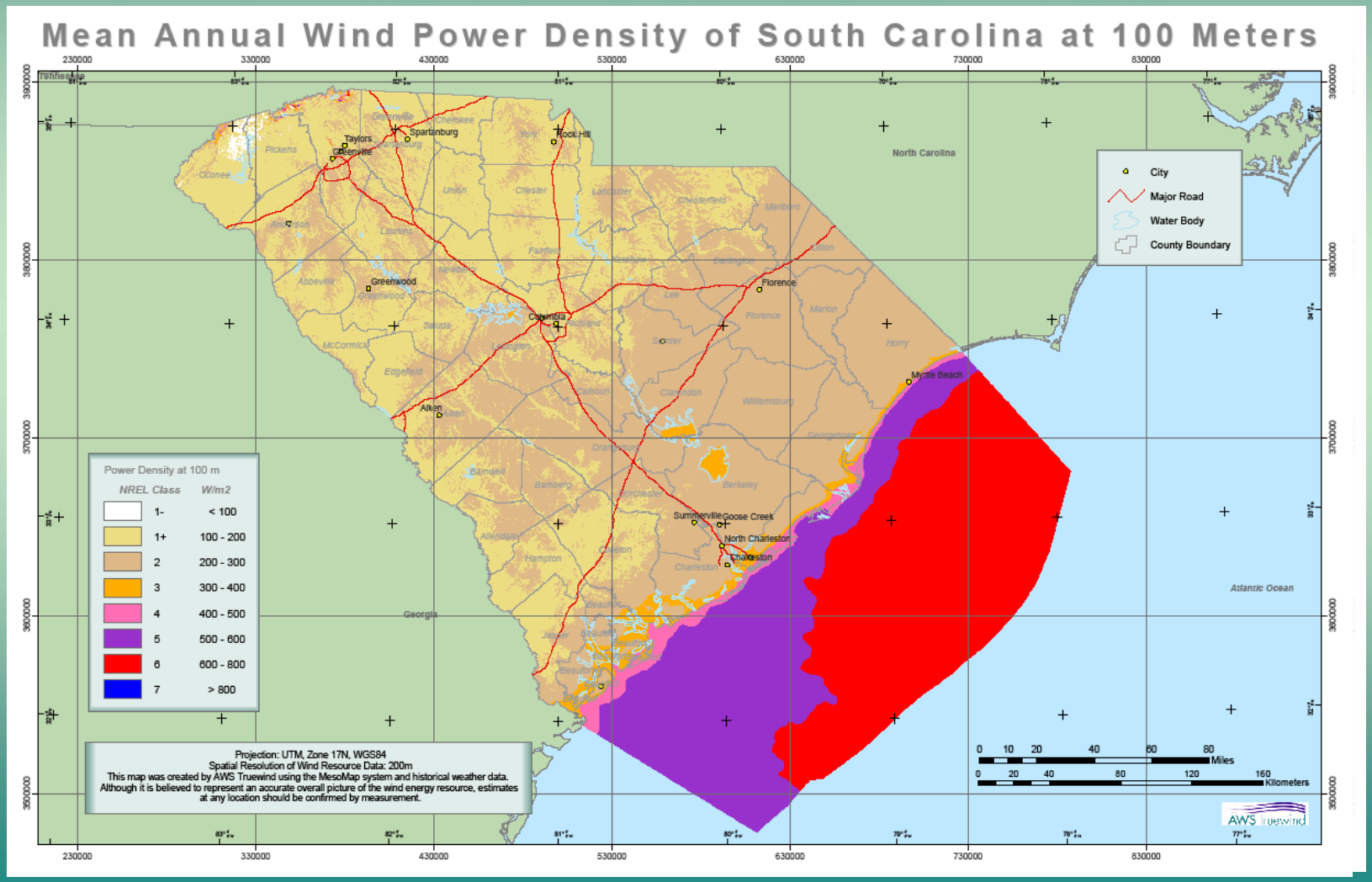


Waties Data: 4.8 m/s

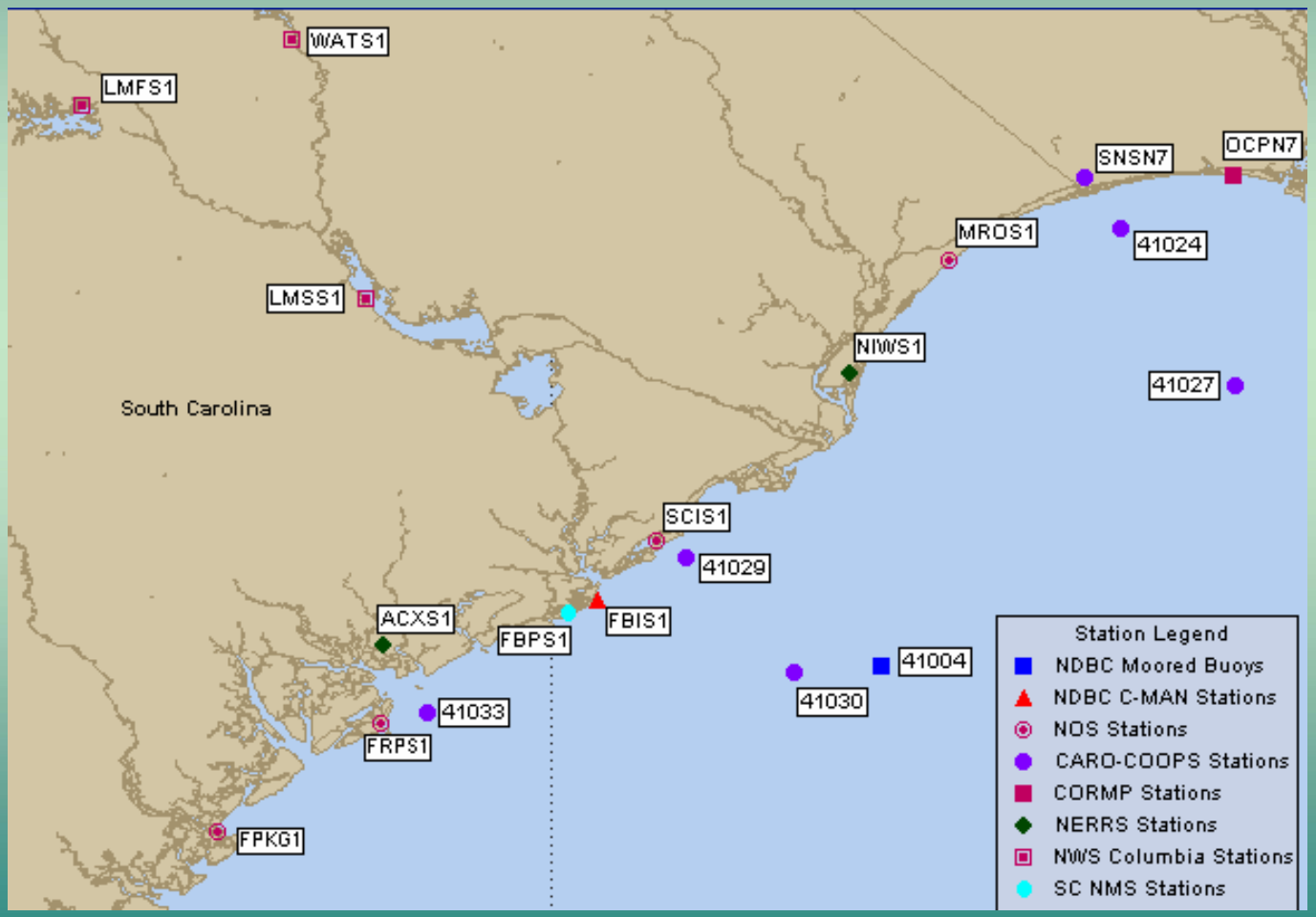
Clemson Model: 5.7-5.9 m/s

AWS Prediction: ~5.75 m/s

50m Tall Tower Data: Implications



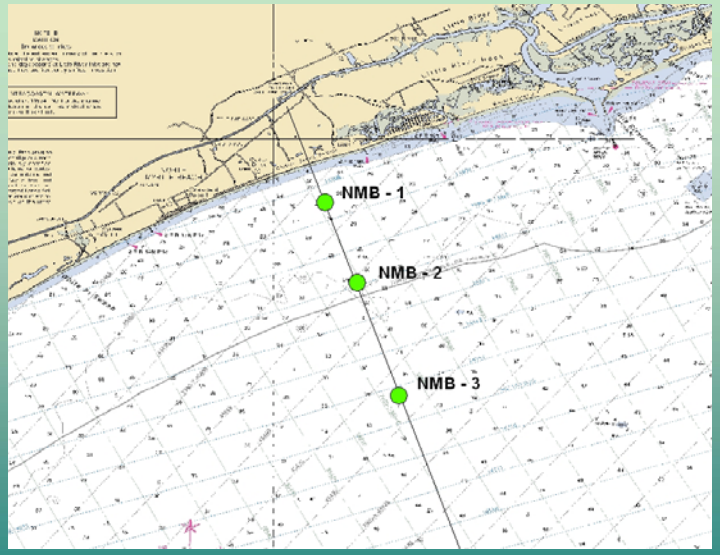
Next Step: Verification



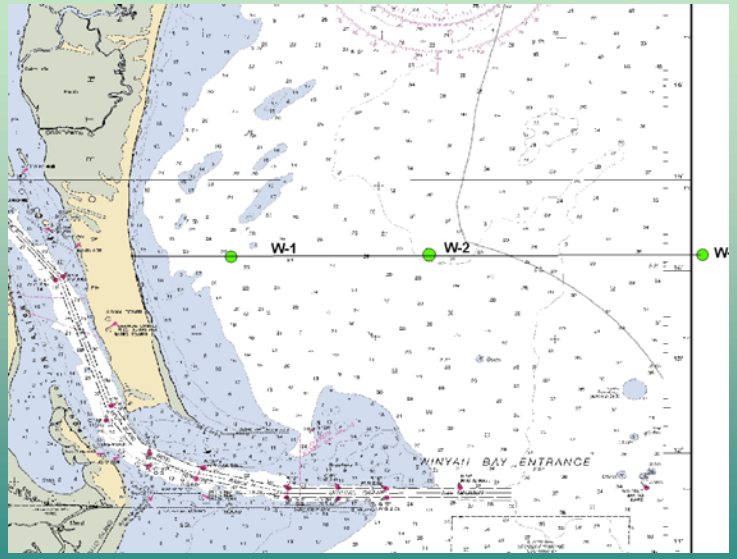
Interactive Map from NOAA's National Data Buoy Center www.ndbc.noaa.gov/

Palmetto Winds Research Project

- DOE Grant provides partial funding, Santee Cooper provided funding to extend study to one year
- 6 instrumentation buoys, 2 shore-based observation stations
- Will study wind, wave, and current energy for foundation design and marine energy potential



North Myrtle Beach



Winyah

Anemometer Tower

60m monopole on pilings

150m lattice tower on gravity foundation

Fig.3: Arkona Becken Südost platform.

SODAR Technology

TRITON SONIC WIND PROFILER

- Collects data without being attended, just like a met mast.
- Data is ready to use, reported just like the anemometry data from a met mast.
- Works under all conditions—made of rugged plastic with polyester lining, has drainage scuppers and other all-weather features
- Patented hex array provides optimal beams that virtually eliminate side lobes.
- Triton is bundled with SkyServe Satellite Wind Data Service to deliver data to any computer from any location in North America.
- Precision-manufactured as a self-contained unit.
- Compact—six feet tall with 6 x 6 footprint.

Triton Profiler Features

- Polyethylene shell
- Non-woven polyester lining*
- Aluminum substructure, stainless steel hardware
- Hexagonal transducer array,* tri-lobed enclosure*
- Vertical recessed array, acoustically transparent plastic protective screen*
- Aluminum sound mirror, large drainage scupper
- Hinged, tool-free latchable front door, array plate, and electronics enclosure
- ARM and Blackfin processors
- SD memory card socket
- Rear door
- Operator panel
- Power consumption: less than 10 watts average
- Orientation sensors
- GPS receiver
- Atmospheric sensors
- Operating range: –40° to 150°F
- Internal nesting locations for up to four 100 AH batteries and two standard five-gallon LPG bottles
- Dimensions: 6' x 6' x 6'
- Weight: under 1000 lbs.
- Integrated 4' x 6' base

Options

- Solar charging packages
- Mirror heater system—computer-controlled 6500 BTU/Hr LPG heater
- Globalstar satellite modem
- Custom enclosed trailer

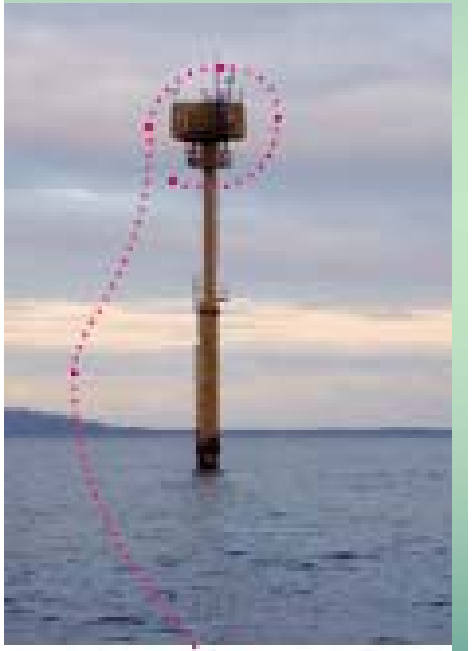
*Patents pending.

TRITON SONIC WIND PROFILER

SECONDWIND
Measurement. Management. And more.

Second Wind Inc. 366 Summer Street, Somerville, MA 02144 USA
Tel. 617-776-8520 • Fax 617-776-0391 • www.secondwind.com

LIDAR Technology



NaiKun deployment offshore in Canada

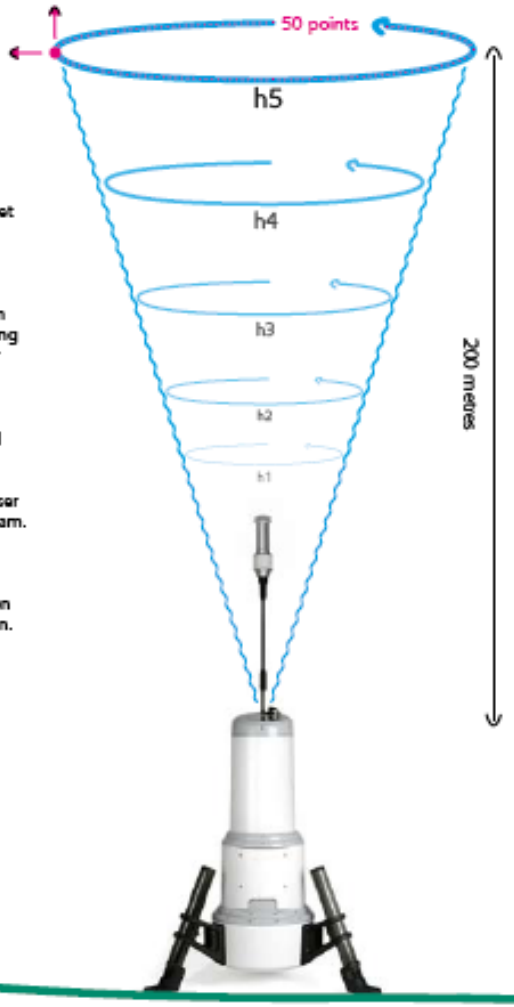
ZephIR® laser anemometer

An eye-safe infrared beam illuminates natural aerosols in the atmosphere (such as dust, pollen and droplets) and a small fraction of the light is backscattered into a receiver. Motion of the target particles along the beam direction leads to a change in the light's frequency through Doppler shift which is then accurately measured.

A conical scan pattern is used to move the beam and intercept the wind at different angles, building up a series of measurements around a disc of air from which the wind speed vector is obtained.

ZephIR obtains each measurement in just 20 milliseconds, and three seconds of data are used to derive the horizontal and vertical wind speed components and wind direction. This can be repeated up to a height of 200 metres, at five user defined heights by focussing the transmitted beam.

At each height a total of 50 points of data are gathered which enhance the quality of measurement, providing additional information on turbulence essential for sites with complex terrain.



technical specification

DIMENSIONS	Optics Pod	345 mm dia. x 660 mm
	Electronics Pod	450 mm dia. x 390 mm
	Battery Pod	550 mm dia. x 290 mm
WEIGHT	Optics Pod	28 kg
	Electronics Pod	24 kg
	Battery Pod	20 kg
	Batteries	44 kg
	Tripod	14 kg
	Met Probe	4 kg
	TOTAL	134 kg
POWER	28v @ 100W continuous 0°C to +25°C	
OPERATING TEMP.	-25°C to +40°C	
CERTIFICATION	Class 1 Laser Product eye safe to IEC/EN 60825 - 1 (2001) Safety requirements to EN61010 - 1 : 2001	
RANGE	Minimum height	10 metres
	Maximum height	200 metres
WIND SPEED	Minimum	2 m/s
	Maximum	70 m/s
LASER WAVELENGTH	1575 nm	
DATA STORAGE	12 months wind data or 24 months with upgrade	
DATA OUTPUT	1 or 3 second average wind data comprising:	

Horizontal wind speed
Vertical wind speed
Direction of wind speed
Turbulence parameter
Gusts
Height reading
Shear
Orientation
Battery status
Status flags
Reference to raw data
Time of day & date
GPS location
Pod temperatures
Temperature
Humidity
Barometric pressure

FOCUS HEIGHTS	5 user programmable heights 50 or 150 data points per height at 50 Hz
REMOTE OPERATIONS	Remote download Remote system integrity check Remote system configuration changes

South Carolina Offshore Wind

Current Status of Investigation

Liz Kress

Principal Engineer – Renewable Energy